National Aeronautics and Space Administration

NASAfacts

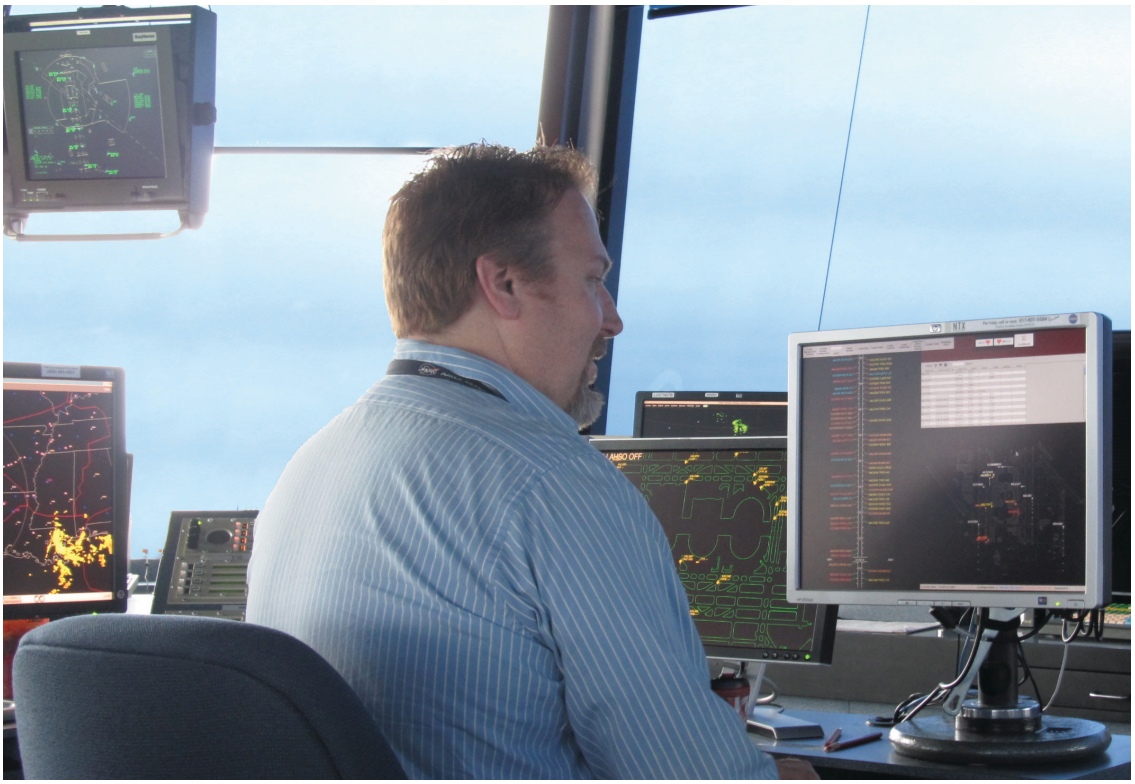
Aviation Systems Division (Code AF) FY13 Technical Highlights

Precision Departure Release Capability (PDRC)

On Aug. 6, 2013, a ceremony was held at FAA headquarters to recognize the formal transfer of the Precision Departure Release Capability (PDRC). Analysis shows that PDRC technology has the potential to benefit more than 65,000 tactical departures per month, nationwide – this includes 34,000 flights per month that can be strategically scheduled into Traffic Management Advisor (TMA) arrival-metering systems even before departing their originating airport. The research team worked closely with the Ft. Worth En Route Center and the Dallas/Ft. Worth Terminal and Tower facilities. The following week, the PDRC research transition was recognized by NASA Administrator, Mr. Charles Bolden, in a keynote address at the AIAA Aviation 2013 conference.

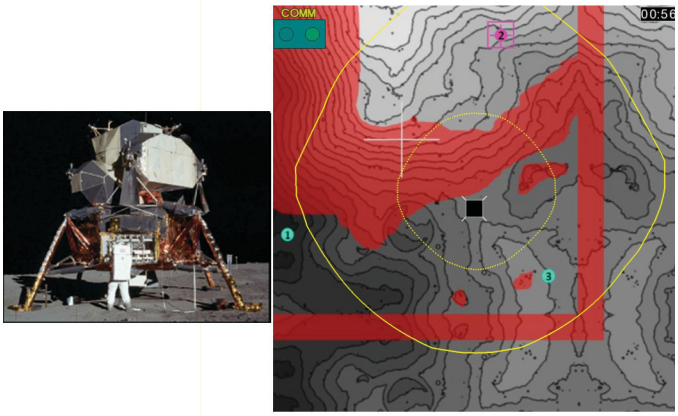
Air Traffic Management Technical Demonstration (ATD)-1

In Sept. 2013, NASA delivered to the FAA a significant portion of the Agency's first Air Traffic Management (ATM) Technology Demonstration (ATD) research and development capability, capping off a year of impressive progress towards field demonstration. The terminal sequencing and spacing (TSS) ground tools of ATD-1 were delivered to the FAA's Time-Based Flow Management (TBFM) Program. In addition to the technology transfer, the Division conducted three major human-in-the-loop (HITL) simulation activities, targeting evaluation of the controller managed spacing (CMS) tools, and successfully demonstrated the integration of NASA's ground-side tools on the FAA's Standard Terminal Automation Replacement System (STARS)-Elite



A TMC in the air traffic control tower at Dallas/Fort Worth International Airport (shown here) uses PDRC to coordinate departure release times with a TMC in the en route Center.

Human-in-the-loop simulation for testing of ATD-1's Controller Managed Spacing tools



Left, Apollo Lunar Exploration Module (LEM); Right, Head Down Display showing LEM with respect to landing site two overlaid on topographical map with yellow fuel contour reference lines

displays, installed in the Division's air traffic control (ATC) simulation lab. Shakedown simulation activities were also completed for a joint NASA Ames-Langley simulation of the Fully-Integrated ATD-1 Test (FIAT), to evaluate the performance of the newly improved ASTAR 12 airborne spacing algorithm.

Ames Simulation Laboratories: SimLabs

NASA Ames' SimLabs facilities (the Vertical Motion Simulator (VMS), the Crew-Vehicle Systems Research Facility (CVSRF), FutureFlight Central (FFC) and two air traffic control simulation laboratories), supported NASA Aeronautics and outside customers, investigating a diverse array of human-piloted vehicles and systems:

- NASA, Draper Laboratory, and MIT's Supervisory Control of a Lunar Lander (SCoLL) experiment utilized an Apollo-like Lunar Lander on the VMS to measure the landing performance of participants under various levels of automation.
- NASA's Rotary Wing Project and the US Army conducted the Good Visual Environments/Degraded Visual Environments (GVE/DVE) Handling Qualities Simulation in the VMS, and evaluated the benefits of increased control augmentation on a partial authority flight control architecture focusing on civil medical evacuation missions in DVE.
- In the CVSRF's Boeing 747-400 cab and the Advanced Concepts Flight Simulator's (ACFS's) Boeing 737-800W simulation model, the Boeing Company collaborated with NASA Ames and the Aviation Safety Program to evaluate Quiet and Efficient Flight Operations.

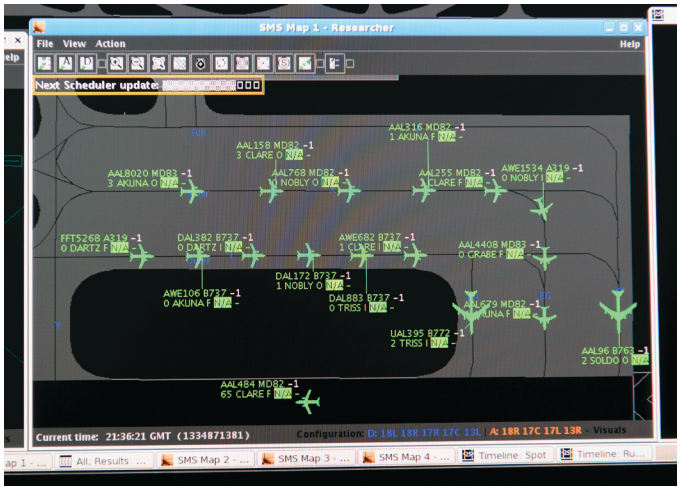
Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS)

In June 2013, the UAS Integrated Test and Evaluation (IT&E) team conducted a series of experiments to measure the time to transmit aircraft state data through the core components of the Live, Virtual, Constructive (LVC) simulation infrastructure, involving teams at NASA Ames, Dryden, and Glenn. The final experiment report was submitted to the Aeronautics Research Mission Directorate (ARMD) as the FY13 Annual Performance Goal (APG) for the UAS in the NAS Project. The Separation assurance/Sense and avoid Interoperability (SSI) sub-project developed and delivered algorithms that provide the UAS's sense-and-avoid (SAA) capabilities. The study provided more data on defining the airborne separation standard "well clear," and the appropriate time and distance thresholds at which to notify the pilot of potential collision situations. In Sept. 2013, the UAS in the NAS project completed its key decision point (KDP) review, validating the research plan for the remaining years of the project.

Dynamic Weather Routes (DWR)

The DWR team continued to work closely with the American Airlines (AA) Integrated Operations Center (IOC) in Ft. Worth, TX to evaluate the tool's capability to find time- and fuel-saving corrections to weather avoidance routes during severe thunderstorm activity. A laboratory evaluation of DWR at NASA Ames took place in Feb.-March 2013, and in July 2013, a second software release of DWR was installed on the AA trial system. Results from AA operational testing showed that AA revenue flights achieved 10% more savings on days where DWR was heavily used by AA vs. days where DWR was lightly used by AA, equating to a savings of 586 flying minutes, or about an $88,000 savings in operating costs, assuming an average total operating cost of $150/minute.

TAIGA running on an iPad



The Spot and Runway Departure Advisor (SARDA)

Traffic Flow Management (TFM)

The TFM team completed a field trial of the San Francisco International Airport (SFO) Ground Delay Program (GDP) parameter selection model. TFM researchers also published the results of a yearlong study examining the potential impact of controlling Hartsfield-Jackson Atlanta International Airport arrivals using a new control strategy called the "TMA Flow Program." Work continued on Traffic and Atmospheric Information for General Aviation (TAIGA), an iPad-based tool for general aviation pilots that will integrate and display weather, ATM, and terrain data with updated aircraft position using built-in GPS technology within the mobile device. The TFM team also participated in a number of environmental aviation forums to share results of recent research.

Airport Surface Operations

In June 2013, NASA and US Airways formally embarked on a Nonreimbursable Space Act Agreement to jointly build and test a prototype decision-support tool for ramp operators at Charlotte-Douglas International Airport (CLT). Under the Agreement, Spot and Runway Departure Advisor (SARDA) functions will be adapted to CLT operations, and NASA and US Airways will develop a customized SARDA User Interface. NASA Ames surface researchers held two workshops at Ames with CLT airport surface subject matter experts (SMEs). In Aug. 2013, the Division hosted a group of researchers from the Deutsche Zentrum für Luft- und Raumfahrt (DLR, the German Aerospace Center) for a workshop to collaborate on a joint airport surface concept document in support of the NASA and DLR formal agreement (signed in Dec. 2012). The teams completed the first version of a joint concept document titled "A Mid-Term Harmonized Concept for Airport Surface Operations" that was delivered in mid-Nov. 2013.

Separation Assurance

In Jan. 2013, Aviation Systems and Human Systems Integration Division researchers completed the first HITL simulation to evaluate how well air traffic controllers can accommodate trajectory-prediction error before a NextGen Trajectory-Based Operations (TBO) concept becomes untenable – or reaches a controller "breakpoint." Preliminary results from the study demonstrated no clear controller "breakpoint," even with the largest errors, as controllers were able to compensate and adapt the advisories suggested by the automated tools to maintain safe separation and deliver arrival aircraft on time. Aviation Systems Division engineers also met with flight operations personnel from Regional-Jet (RJ) operator SkyWest Airlines to discuss NASA findings that suggest that SkyWest could save upwards of 50 lbs. of fuel per RJ flight by altering their arrival procedures to use more optimal flight path angles that would avoid the need to deploy speedbrakes. NASA developed an algorithm that can inform RJ operators what flight path angle would be optimal given the prevailing winds, route of flight, and other factors.

Super Density Operations (SDO)

Development continued on the Terminal Tactical Separation Assured Flight Environment (T-TSAFE), a tactical conflict detection and resolution tool. NASA team members tasked Raytheon to identify the inputs available in STARS that could be used by the T-TSAFE algorithm for a near term implementation. They identified that most of the inputs were either available or T-TSAFE had a work around for them.

Dynamic Airspace Configuration (DAC)

Investigations into the Operational Airspace Sectorization Integrated System (OASIS) algorithm were completed after a part-task HITL evaluation in Jan. 2013 in the Airspace Operations Laboratory at NASA

Ames. Eight retired FAA personnel served as experiment participants, evaluating the user interface as well as the underlying algorithm, and gave very positive feedback.

System Portfolio Analysis (SPA)

Research was published at the AIAA Aviation 2013 conference on the effectiveness of incentivizing Automatic Dependent Surveillance-Broadcast (ADS-B) equipage through preferential merge re-sequencing, which is a "best-equipped best-served" ATM policy meant to accelerate the adoption of ADS-B Out by giving an operational incentive to airlines, to invest in upgrading their fleet. This re-sequencing is accomplished by favoring high-equipped aircraft over low-equipped aircraft at en-route merge-fixes, thus reducing flight time for high-equipped aircraft. An analysis of traffic at Phoenix Sky Harbor International Airport was performed, focusing on a benefit analysis for nationwide as well as regional airlines.

Single Pilot Operations (SPO)

In Aug. 2013, a simulation study was conducted to examine ground-supported single pilot operations (SPO) in the ACFS SimLabs facility. The study examined very high workload, off-nominal and emergency scenarios with the participation of 19 professional air transport pilots in two-person commercial crews assigned to three different conditions: 1) together on the flight deck as in current operations (baseline), 2) one pilot on the flight deck and a "ground dispatch pilot" at a ground station with basic tools, and 3) one pilot on the flight deck and a ground dispatch pilot at a ground station with additional tools and displays to aid in air-ground collaboration. Analysis of results is underway.

Technical Interchange Meetings

In FY 2013, the Division worked with international partners in nearly all the research areas of the Division. Two international workshops were held in Dec. 2012 to kick off collaboration agreements between NASA and the German Aerospace Center (DLR) and the National Aerospace Laboratory of the Netherlands (NLR). In addition to discussions with American Airlines and US Airways, research teams worked with Delta Airlines, Passur Aerospace, and Virgin America to share research ideas and gain operational feedback. Technical interchange meetings were also held with Airbus, Boeing, the Japanese Aerospace Exploration Agency (JAXA), Eurocontrol, the Electronic Navigation Research Institute (ENRI), as well as numerous partners in the US government. The Division hosted a first of its kind, ATM human factors workshop in April 2013. Division researchers also participated in a technical workshop on integrated air and space traffic management held at NASA Ames which included participation from the FAA, academia, and the Air Force Research Lab.

Outreach

Division researchers were once again prominent participants in promoting the Agency's work. Several Division presenters were showcased in various NASA summer lecture series, who gave technical briefings on VMS simulation operations and fidelity, NextGen work, Environmental Impact of Air Traffic Operations, TFM, Decision Making in Aviation Operations, and Air Traffic Automation. Division staff fielded questions from the general public about aviation and NASA's research at Palo Alto Airport Day in Sept. 2013. SimLabs staff and personnel directly supported and presented at the Third Cargo Airships for Northern Operations Workshop at the University of Alaska, Anchorage campus. The SimLabs performed an outstanding outreach service for the entire Agency, conducting 325 tours for over 3000 total visitors over its major simulation facilities and participating in Center and community outreach events.

Technical Publications

The Division published a total of 70 technical papers in FY13, in journals, at technical conferences, and in NASA technical publications.

In Memory of Steven M. Green

In Aug. 2013, the Aviation Systems Division sadly lost one of its founding members, Steve Green. Steve joined the NASA family in 1985, when he was recruited by a small project in aircraft trajectory prediction. As one of the four inventors of the Center/TRACON Automation System (CTAS), Steve developed and validated the En-route Descent Advisor automation tool that will begin national deployment in 2014. He pioneered the integration of airborne flight management systems with ground-based automation for air traffic management, and led the first-ever CTAS field trials. We all miss Steve very much and are so grateful for his contributions and tremendous friendship and support.

For more information, please visit
www.aviationsystems.arc.nasa.gov

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